

CPUE

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Hypothesis

- 1) H_0 : There is no difference in cpe (catch/hour) among years 2013 - 2016.
- 2) H_0 : There is no differenc~~t~~ in cpe for quality length (300mm) and larger largemouth bass among years 2013 - 2016.
- 3) H_0 : There is no difference in cpe for largemouth bass smaller than quality length (300mm) among years 2013 - 2016.

1) H_0 : There is no difference in cpe (catch/hour) among years 2013 - 2016.

Load and Prepare Data

Load Data

```
gcat <- read.csv("Data/Clean-Data/CPUE-gcat_2013-2016.csv") %>% filter(Species == 317) %>% arrange(Site, Year)

gcat$Site <- factor(gcat$Site)

cpeSum <- aggregate(cpe.hr ~ Year + Site, data = gcat, FUN = sum)
```

Year	Site	cpe.hr
2014	1	45.378151
2013	2	86.746988
2014	2	87.032967
2015	2	19.169329
2016	2	59.602649
2013	4	58.009479
2014	4	19.933555
2015	4	31.259045
2016	4	48.949320
2015	5	4.225352
2013	6	4.712042
2014	6	21.021898
2015	6	17.716535
2016	6	44.628099
2013	8	38.709677
2014	8	47.787611
2015	8	117.249698
2016	8	166.591422
2013	10	20.571429
2014	10	27.799228
2016	10	5.872757

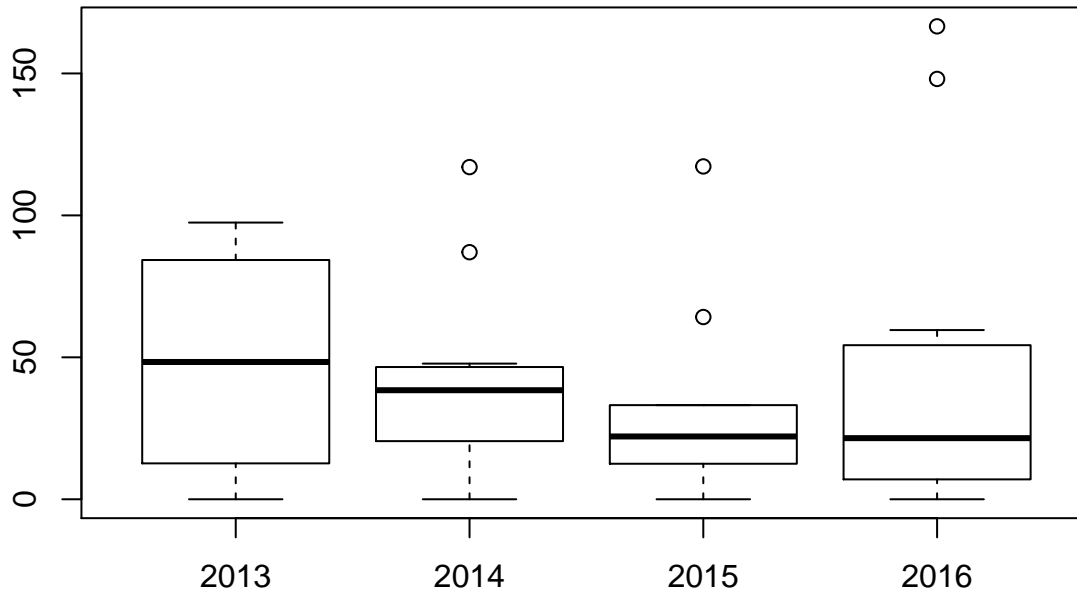
	Year	Site	cpe.hr
22	2014	11	117.009751
23	2015	11	33.162743
24	2016	11	26.438188
25	2014	12	36.468886
26	2015	12	12.514484
27	2016	12	10.404624
28	2016	13	0.000000
29	2016	14	8.135593
30	2013	15	81.818182
31	2014	15	40.346409
32	2015	15	25.079164
33	2016	15	16.618581
34	2014	16	45.120859
35	2013	18	97.472924
36	2014	18	16.775396
37	2015	18	64.197531
38	2016	18	148.064516
39	2013	19	0.000000
40	2014	19	0.000000
41	2015	19	0.000000
42	2016	19	0.000000

Test Hypothesis 1

```
aov1 <- aov(cpe.hr ~ Year, data = cpeSum)
summary(aov1)
```

```
##           Df Sum Sq Mean Sq F value Pr(>F)
## Year       1    121   121.3    0.071  0.792
## Residuals 40  68501   1712.5
```

Mean Catch Per Hour



```
## Year cpe.hr
## 1 2013 48.35958
## 2 2014 38.40765
## 3 2015 22.12425
## 4 2016 21.52838
```

Results H_0 1

There is *no significant difference* in CPUE between years ($F_{1,40} = 0.071$, $p = 0.792$). The median CPUE was 48.36 in **2013**, 38.41 in **2014**, 22.12 in **2015**, 21.53 in **2016**.

2) H_0 : There is no different in cpe for quality length (300mm) and larger largemouth bass among years 2013 - 2016.

Load and Prepare Data

Load Data with Gcat and make Q+ and Q-

```
## Year Site effort Species gcat caught cpe.hr
## 1 2014 1 0.2644444 317 stock 9 34.03361
## 2 2014 1 0.2644444 317 quality 3 11.34454
## 3 2014 1 0.2644444 317 substock 0 0.00000
## 250 2016 19 0.2322222 317 preferred 0 0.00000
## 251 2016 19 0.2322222 317 memorable 0 0.00000
## 252 2016 19 0.2322222 317 trophy 0 0.00000
```

```
##           Year
## gcat      2013 2014 2015 2016
## memorable    0    0    0    0
## preferred   14   18   15   10
## quality     39   57   38   47
## stock       38   65   14   53
## substock    16    3   13   34
## trophy      0    0    0    0
```

Make Qcat Variable and Data Frame

```
Qcat <- gcat %>% mutate(gcatQ = mapvalues(gcat, from = c("substock", "stock",
  "quality", "preferred", "memorable", "trophy"), to = c("quality-", "quality-",
  "quality+", "quality+", "quality+", "quality+"))) %>% dplyr::select(Year,
  Site, gcatQ, cpe.hr)
```

Create Data Frame With Only Quality + Fish

```
Qpls <- Qcat[Qcat$gcatQ == "quality+", ]
Qpls$gcatQ <- droplevels(Qpls$gcatQ)
```

```
str(Qpls)
```

```
## 'data.frame': 168 obs. of 4 variables:
## $ Year : int 2014 2014 2014 2014 2013 2013 2013 2013 2014 2014 ...
## $ Site : Factor w/ 15 levels "1","2","4","5",...: 1 1 1 1 2 2 2 2 2 2 ...
## $ gcatQ : Factor w/ 1 level "quality+": 1 1 1 1 1 1 1 1 1 1 ...
## $ cpe.hr: num 11.3 0 0 0 23.7 ...
```

```
Qpls.sum <- aggregate(cpe.hr ~ Year + Site, data = Qpls, FUN = sum) %>% arrange(Site,
  Year)
```

Year	Site	cpe.hr
2014	1	11.344538
2013	2	23.658269
2014	2	35.604396
2015	2	0.000000
2016	2	23.841060
2013	4	23.886256
2014	4	11.960133
2015	4	26.049204
2016	4	17.799753
2015	5	4.225352
2013	6	0.000000
2014	6	15.766423
2015	6	3.543307
2016	6	14.876033
2013	8	8.602151
2014	8	23.893805
2015	8	52.110977
2016	8	24.379233
2013	10	8.228571
2014	10	22.239382
2016	10	5.872757

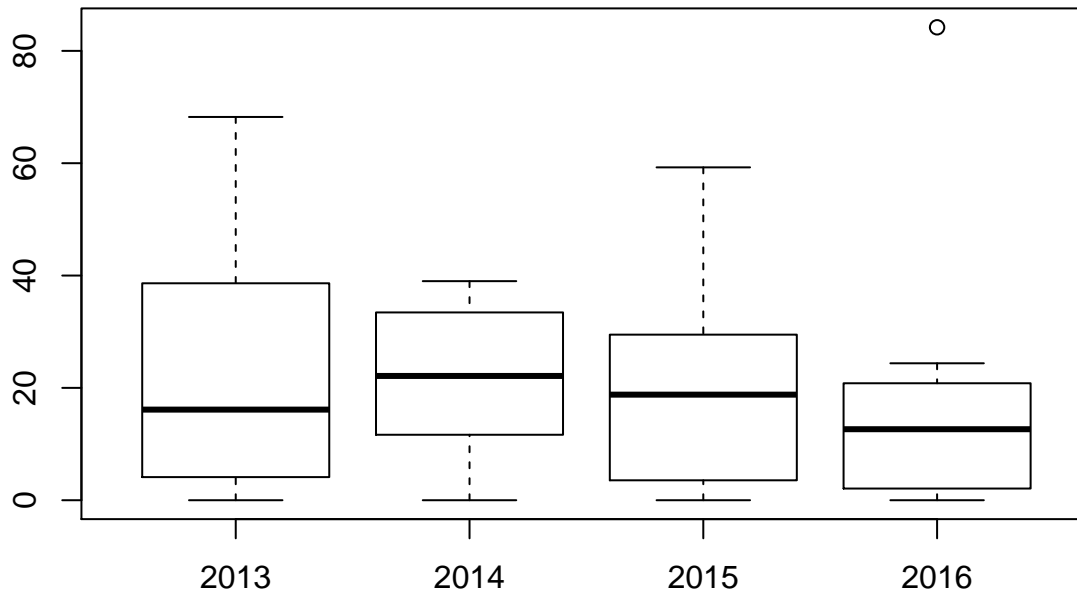
	Year	Site	cpe.hr
22	2014	11	39.003250
23	2015	11	29.477994
24	2016	11	17.625459
25	2014	12	31.259045
26	2015	12	12.514484
27	2016	12	10.404624
28	2016	13	0.000000
29	2016	14	0.000000
30	2013	15	53.359684
31	2014	15	22.007132
32	2015	15	25.079164
33	2016	15	4.154645
34	2014	16	38.675022
35	2013	18	68.231047
36	2014	18	10.065238
37	2015	18	59.259259
38	2016	18	84.193548
39	2013	19	0.000000
40	2014	19	0.000000
41	2015	19	0.000000
42	2016	19	0.000000

Test Hypothesis 2

```
aov.Qpls <- aov(cpe.hr ~ Year, data = Qpls.sum)
summary(aov.Qpls)
```

```
##           Df Sum Sq Mean Sq F value Pr(>F)
## Year         1    208   207.5    0.515  0.477
## Residuals   40 16111   402.8
```

Mean Catch Per Hour Quality +



```
##   Year  cpe.hr
## 1 2013 16.13021
## 2 2014 22.12326
## 3 2015 18.79682
## 4 2016 12.64033
```

Results H_0 2

There is *no significant difference* in CPUE for fish > Quality length (300mm) among years 2013 - 2016 ($F_{1,40} = 0.515$, $p = 0.477$). The median CPUE for largemouth bass Quality length and greater was 16.13 in **2013**, 22.12 in **2014**, 18.80 in **2015**, 12.64 in **2016**.

3) H_0 : There is no difference in cpe for largemouth bass smaller than quality length (300mm) among years 2013 - 2016.

Load and Prepare Data

Create Q- Data Frame

```
Qless <- Qcat[Qcat$gcatQ == "quality-", ]
Qless$gcatQ <- droplevels(Qless$gcatQ)
```

```
str(Qless)
```

```
## 'data.frame': 84 obs. of 4 variables:
## $ Year : int 2014 2014 2013 2013 2014 2014 2015 2015 2016 2016 ...
## $ Site : Factor w/ 15 levels "1","2","4","5",...: 1 1 2 2 2 2 2 2 2 2 ...
## $ gcatQ : Factor w/ 1 level "quality-": 1 1 1 1 1 1 1 1 1 1 ...
## $ cpe.hr: num 34 0 35.5 27.6 11.9 ...
```

```
Qless.sum <- aggregate(cpe.hr ~ Year + Site, data = Qless, FUN = sum) %>% arrange(Site,
Year)
```

Year	Site	cpe.hr
2014	1	34.033613
2013	2	63.088718
2014	2	51.428571
2015	2	19.169329
2016	2	35.761589
2013	4	34.123223
2014	4	7.973422
2015	4	5.209841
2016	4	31.149567
2015	5	0.000000
2013	6	4.712042
2014	6	5.255475
2015	6	14.173228
2016	6	29.752066
2013	8	30.107527
2014	8	23.893805
2015	8	65.138721
2016	8	142.212190
2013	10	12.342857
2014	10	5.559846
2016	10	0.000000

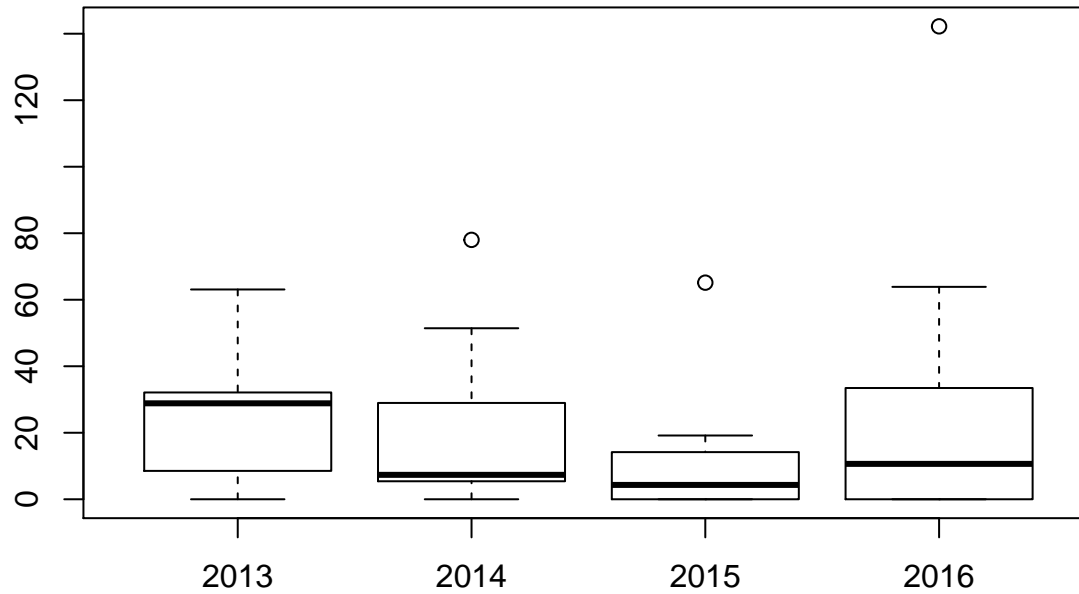
	Year	Site	cpe.hr
22	2014	11	78.006501
23	2015	11	3.684749
24	2016	11	8.812729
25	2014	12	5.209841
26	2015	12	0.000000
27	2016	12	0.000000
28	2016	13	0.000000
29	2016	14	8.135593
30	2013	15	28.458498
31	2014	15	18.339277
32	2015	15	0.000000
33	2016	15	12.463935
34	2014	16	6.445837
35	2013	18	29.241877
36	2014	18	6.710158
37	2015	18	4.938272
38	2016	18	63.870968
39	2013	19	0.000000
40	2014	19	0.000000
41	2015	19	0.000000
42	2016	19	0.000000

Test Hypothesis 3

```
aov.Qless <- aov(cpe.hr ~ Year, data = Qless.sum)
summary(aov.Qless)
```

```
##           Df Sum Sq Mean Sq F value Pr(>F)
## Year       1     12    11.5    0.014  0.906
## Residuals 40  32690   817.2
```

Mean Catch Per Hour Quality–



```
##   Year   cpe.hr
## 1 2013 28.85019
## 2 2014  7.34179
## 3 2015  4.31151
## 4 2016 10.63833
```

Results H_0 3

There is *no significant difference* in CPUE for fish < Quality length among years 2013 - 2016 ($F_{1,40} = 0.014$, $p = 0.906$). The median CPUE for largemouth bass less than quality length was 28.85 in **2013**, 7.34 in **2014**, 4.31 in **2015**, 10.64 in **2016**.

